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POSTPRINT

ARFF ULTRA HIGH PRESSURE FIRE FIGHTING SYSTEMS (BRIEFING CHARTS)

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14. ABSTRACT

The Air Force Research Laboratory has developed Ultra High Pressure (UHP) fire fighting as a method to reduce the amount of agent and extinguishment time required for fuel fires. Initial work was conducted on a 14 gpm system, but has been scaled up to 300 gpm. The effort included large scale experiments to demonstrate an overall reduction of agent usage to 28% of the amount required using conventional technology. UHP fire fighting is now fully developed and five trucks are being deployed to Air Force fire fighters for familiarization and operational verification. The first production buy is expected to occur in 2010.

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AFRL/RXQD Fire Research Group

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ARFF
Ultra High Pressure Fire Fighting Systems

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Tyndall Air Force Base, Florida

Overview

- AFRL Fire Research Group: Who we are and what we do
- Partnerships
- Fire Research Goals

Fire Research Group

- **Mr. Virgil Carr:** Fire Research Program Manager
- **Dr. Pat Sullivan:** Environmental Research Engineer
- **2nd Lt. Eric DeGuzman:** Project Officer
- **Mr. Steven Wells:** Contract Group Leader
- **Dr. Doug Dierdorf:** Chief Scientist and Fire Chemistry
- **Dr. Mark Enlow:** Research Chemist
- **Ms. Jennifer Kalberer:** Environmental Engineer and Technical Writing
- **Mr. John Hawk:** Mechanical Engineer and Munitions Fire Protection
- **Mr. Ramon Sellers:** Mechanical Engineer
- **Mr. Parren Burnette:** Mechanical Engineer
- **Mr. Kris Cozart:** Mechanical Engineer
- **Mr. Mike McDonald:** Mechanical Engineer
- **Ms. Kim Barrett:** FAA Project Officer and Engineering Assistant
- **Mr. Richard Campbell:** Chemist
- **Mr. Chris Menchini:** Mechanical Engineer
- **Mr. Bill Fischer:** Live Fire Operations Leader and Fire Technician
- **Mr. Al Savejs:** Fire Technician
- **Mr. Rick Brill:** Fire Technician
- **Ms. Kathy Latza:** Administrative Support Staff
- **Ms. Peggy Allen:** Environment, Safety and Records Management

Mission & Objectives

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- Conduct Exploratory and Advanced Research in Fire Fighting and Rescue Technologies
- Develop Improved:
  - Suppression/mitigation agents
  - Agent application techniques and
  - Specialized equipment
- Required to:
  - Support Air Force firefighters
  - Enhance deployed operations and
  - Counter new or evolving fire threats to DoD/Federal weapons systems and operations

Customers and Collaborations

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FLORIDA STATE UNIVERSITY

MFRI

UNIVERSITY OF MARYLAND

NC STATE UNIVERSITY

UNIVERSITY OF DELAWARE

UNIVERSITY OF FLORIDA

University of Delaware
Center for Composite Materials

OSHKOSH

Fike CORPORATION

PYROTECH INTERNATIONAL

BOEING

TASK FORCE TIPS

AMEREX

ORBITEC

CAT PUMPS

ADVANCING AVIATION FIRE FIGHTING TECHNOLOGY
CRASH RESCUE
AROUND THE WORLD

ANSUL

rosenbauer

AKRON BRASS COMPANY

FAA TECHNICAL CENTER

ESTCP

NAWC
NAVAL AIR WARFARE CENTER

NAVSEA
CRANE
Surface Warfare Center Division

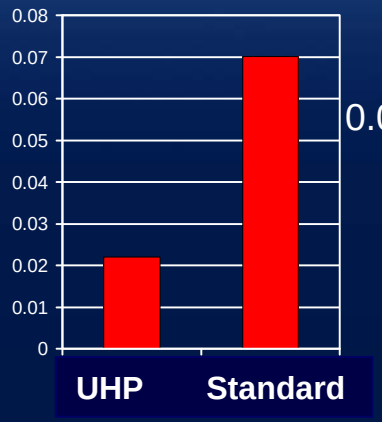
Fire Research Goals

- Provide breakthrough fire fighting technologies to the warfighter
- Maintain worldwide leadership in aircraft rescue and fire fighting science
- Transfer Air Force fire fighting technologies to meet needs of civil aviation
- Leverage unique facilities and capabilities to control R&D costs
  - Support DoD and civilian operational requirements
  - Provide one-of-a-kind fire protection evaluations
  - Provide experiments benefiting military and civilian firefighter needs at minimum cost
- Provide capabilities to protect future weapons systems
  - Identify fire hazards of new materials
  - Develop technologies to mitigate these hazards

UHP Fire Fighting Program Objectives

- Develop Requirements for a Deployable Fleet of Next Generation UHP-capable ARFF Vehicles
- Reduce Agent Requirements
- Reduce Fire Equipment Size
- Improve Ease of Operation
- Gain Operational Experience with Air Force Firefighters

Measured Fire Fighting Effectiveness (gal/ft^2)



0.07 gal/ft^2

0.022 gal/ft^2

Standard P-19

VS.

Future ARFF Vehicle

UHP History

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Oct 2002: 14 gpm FRE Fire

Mar 2003: Fielded 3 FRE in Iraq

Apr 2004: 100 gpm UHP Skid

Aug 2004: 200 gpm UHP T1500

Initial Testing of the FRE

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- John Deere Military Gator
- Rosenbauer Ultra High Pressure System
  - 1500 psi (100 Bar)
  - 14 gpm (53 l/min)
  - Variable Stream – Variable Aspiration Nozzle
- Unprecedented Firefighting Capability
  - 700 ft2 Pool Fire JP-8 – 23 seconds/4 gallons 3% AFFF/Water
  - F 100 3 Dimensional Fire (new Halon 3D Standard) – 20 seconds/3.3 gallons
- Demonstrated Need to
  - Increase pump and engine capacity
  - Marry to Air Drop Certified Platform

FRE-FIRE VEHICLE RESULTS

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- 85% reduction in water
- 50% reduction in fire fighting effort
- 4 fold increase in hose length

Click image to play

FRE Fire Video

Click on image to play

AIR DROP CERTIFIED

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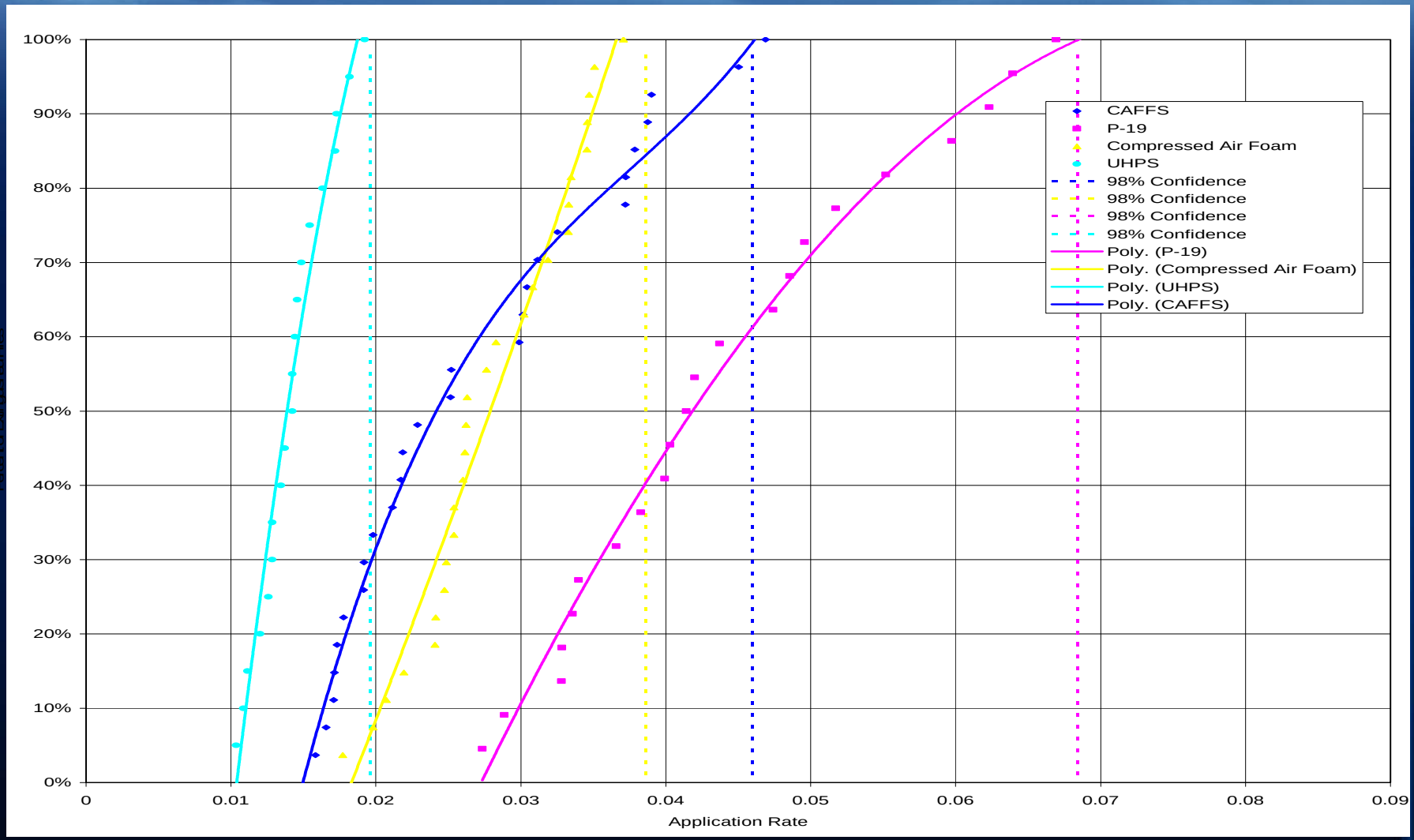
- Certified for Air Drop (3X from 1500 ft.), fully operational
- Also tested on Polaris Chassis (Alternate)
- Lab FRE-Fire efforts end

FEET Test Results



Prototype 200 gpm UHP Crash Vehicle

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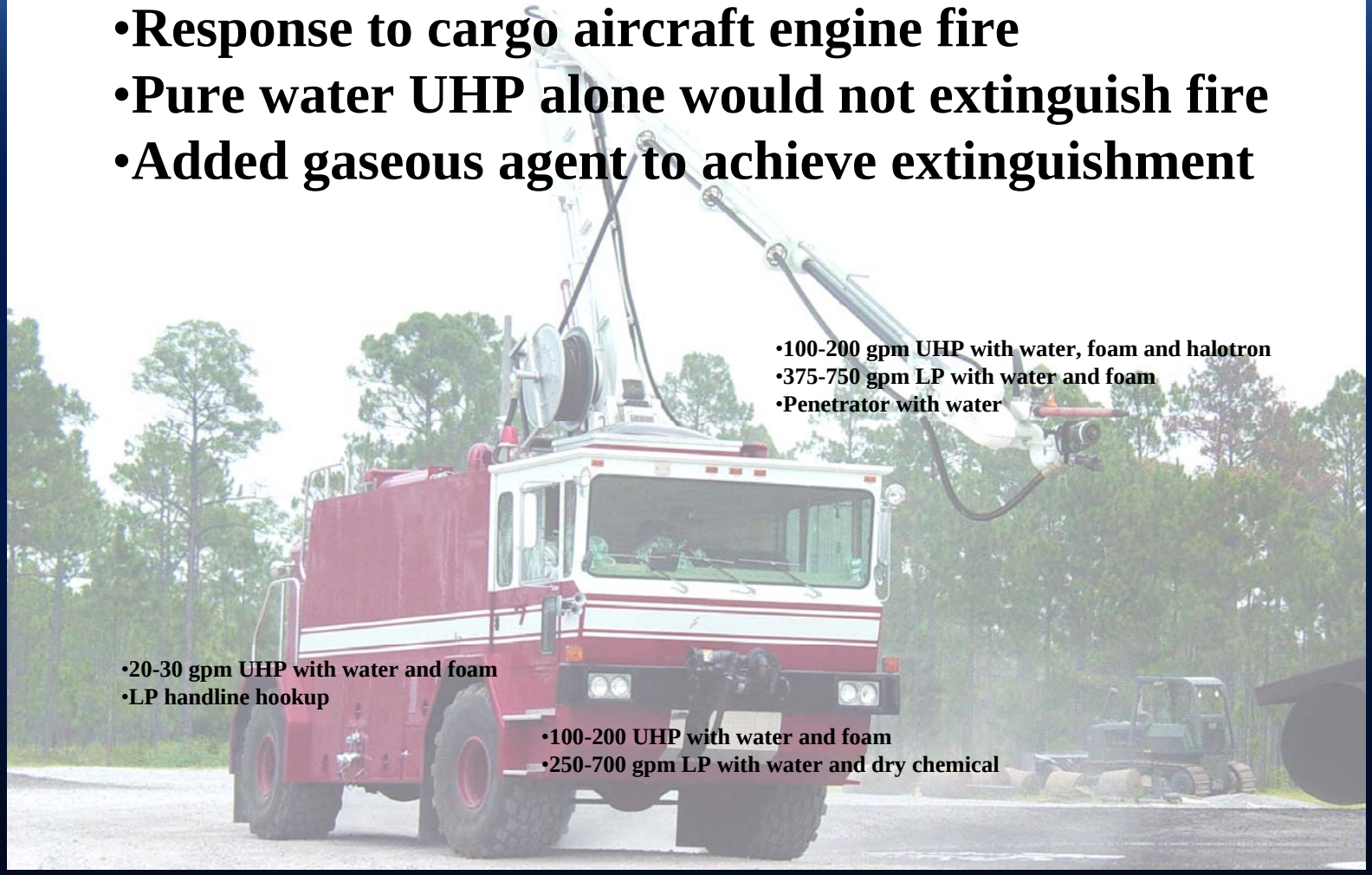
- **Response to cargo aircraft engine fire**
- **Pure water UHP alone would not extinguish fire**
- **Added gaseous agent to achieve extinguishment**



Prototype 300 gpm UHP P-19 Design

Agent Delivery Systems

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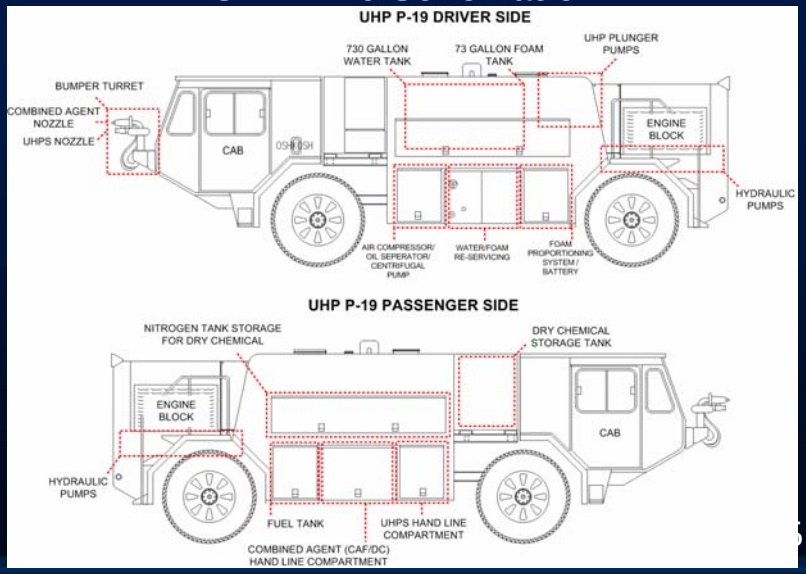
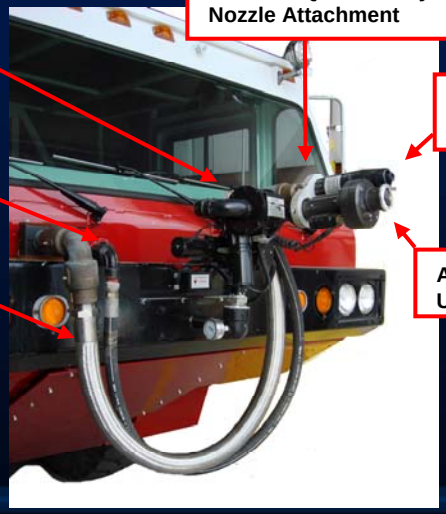
- Ultra high pressure (UHP)
  - 300 GPM bumper turret
  - 30 GPM 150 ft handline
- Compressed air foam (CAF)
  - 300 GPM bumper turret
  - 45 GPM 100 ft handline
- Dry chemical (PKP)
  - 7 pps bumper turret
  - 5 pps 100 ft handline

UHP P-19

UHP P-19 Schematic

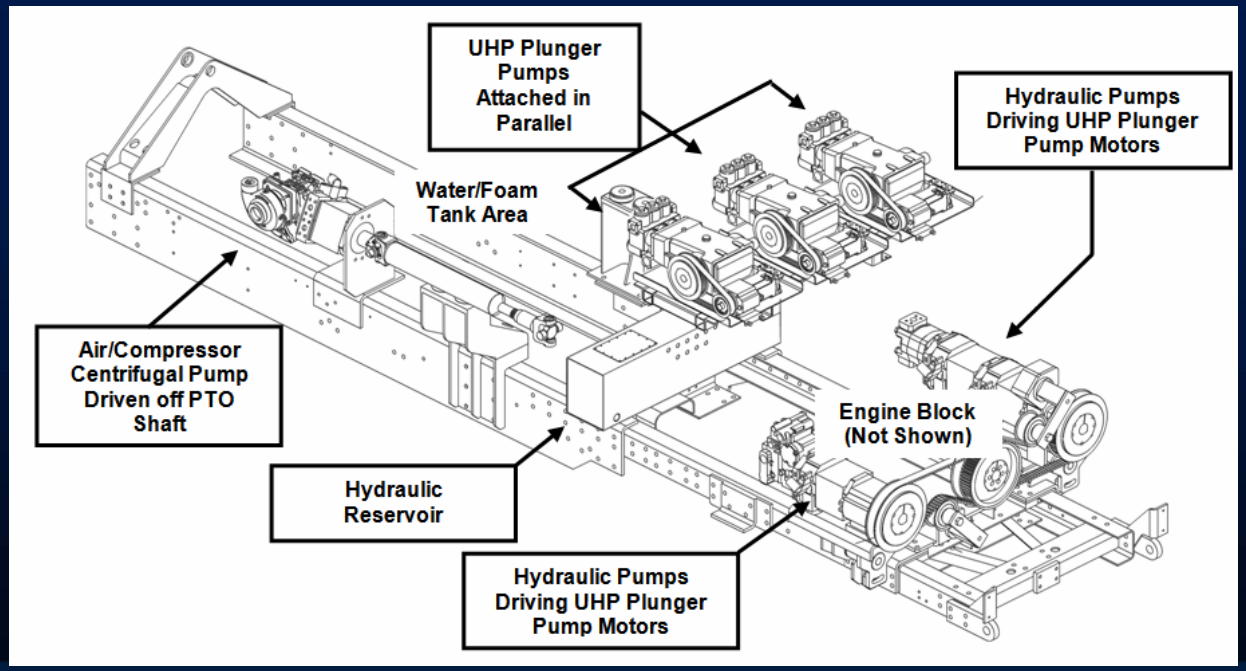




Design Summary

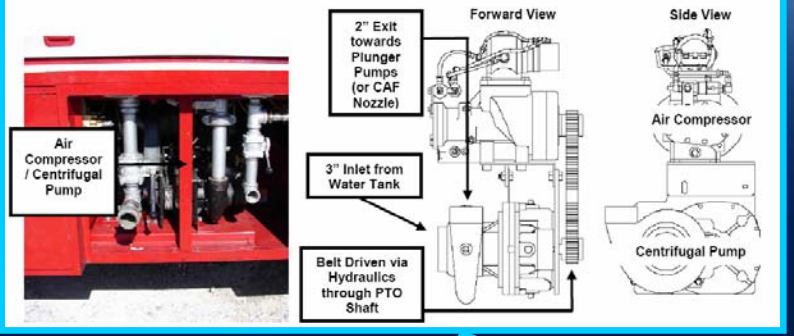
Distinguishing Features

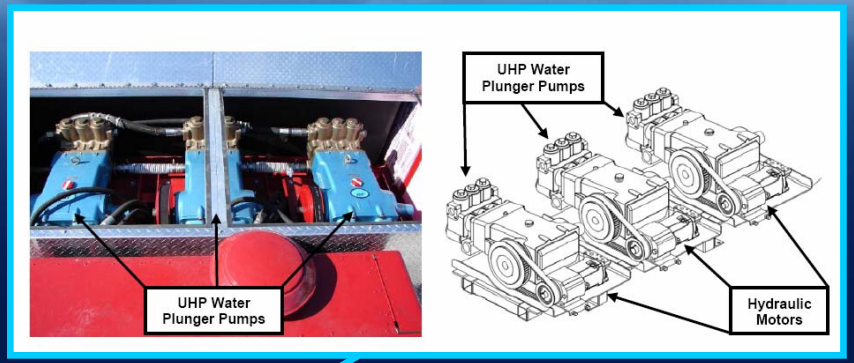
- Hydraulically Controlled Fire Fighting Pumps
  - 3 - 100 GPM Reciprocating UHP Plunger Pumps totaling 300 GPM
  - 300 GPM Combination Centrifugal Pump/Air Compressor
  - UHP Foam Proportioning System
- 730 Gallon Water/73 Gallon Foam Combination Tank
- Removal of Roof Turret
- Prototype UHP Nozzle and Turret Design

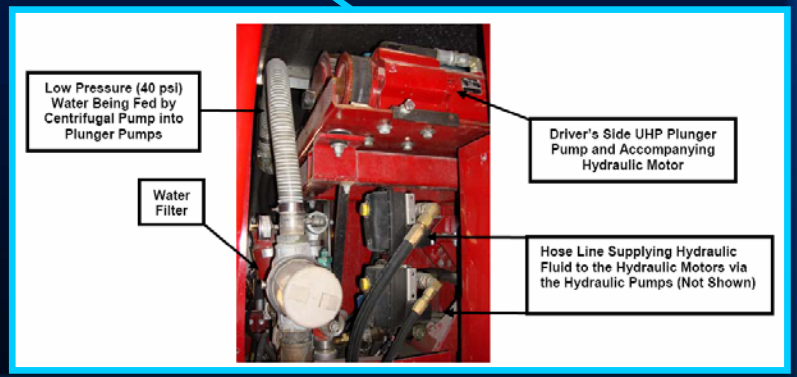


Design Summary

Distinguishing Features





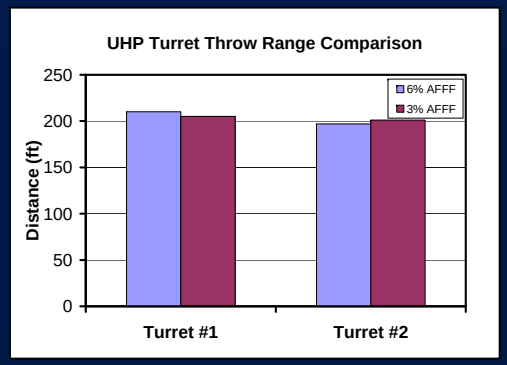


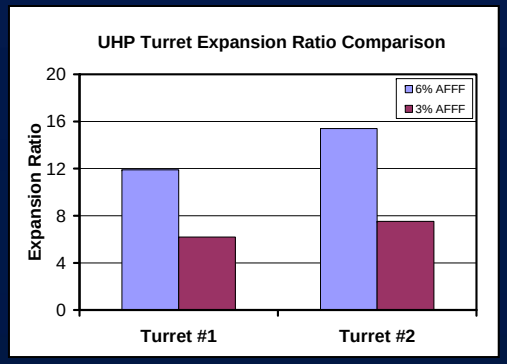
Nozzle Performance Evaluation

UHP Nozzle Flow Characterization

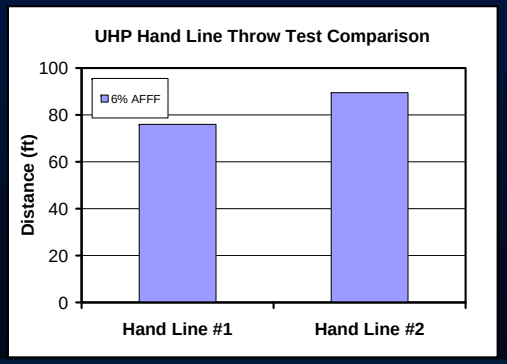
- UHP turret nozzles from 2 suppliers performed comparably
- Improved handline performance on UHP P-19 over smaller scale UHP vehicles

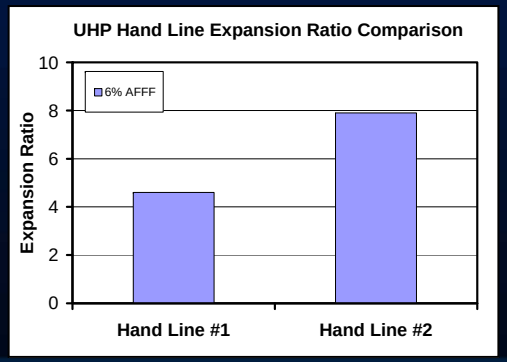
UHP Turret Nozzle Comparison





UHP Hand Line Nozzle Comparison





UHP 300 GPM UHP Tested Nozzles & Turrets

Elkhart Brass

Akron Brass

UHP 30 GPM UHP Tested Handlines

Akron Brass

AFRL/RXQD Design

Fire Video

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Existing UHP P-19 Pump System

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3 Piston Pumps

+ 4 Hydraulic Pumps

+ 4 Hydraulic Motors

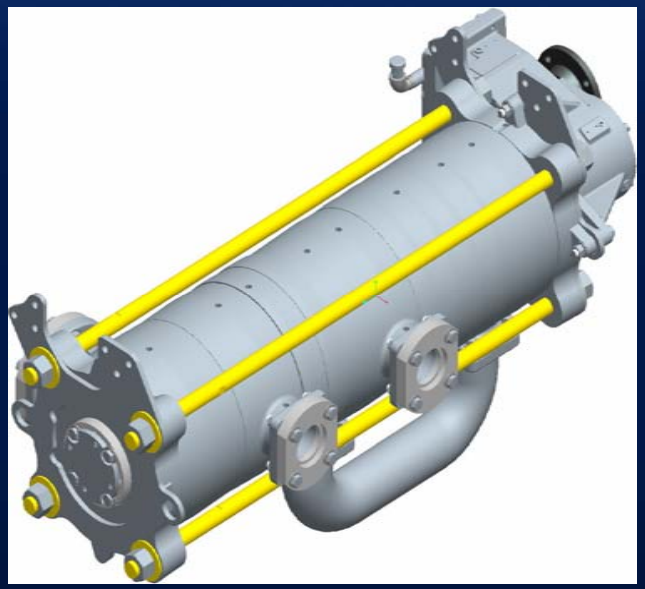
+ 4 PTOs

+ 1 Centrifugal Pump

+ 30 gal Hydraulic Tank

EQUALS
A LOT OF SPACE
&
A LOT OF POWER

1 Centrifugal Pump + 1 PTO =

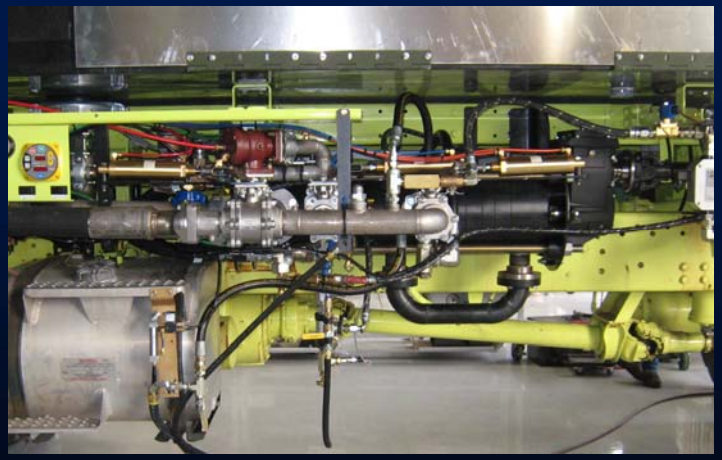


- Reduced Size
- Reduced Weight
- More space for agent
- Simplified operation and maintenance

PERMITS ORIGINAL 1000 GALLON CAPABILITY

300 gpm UHP Centrifugal Pump

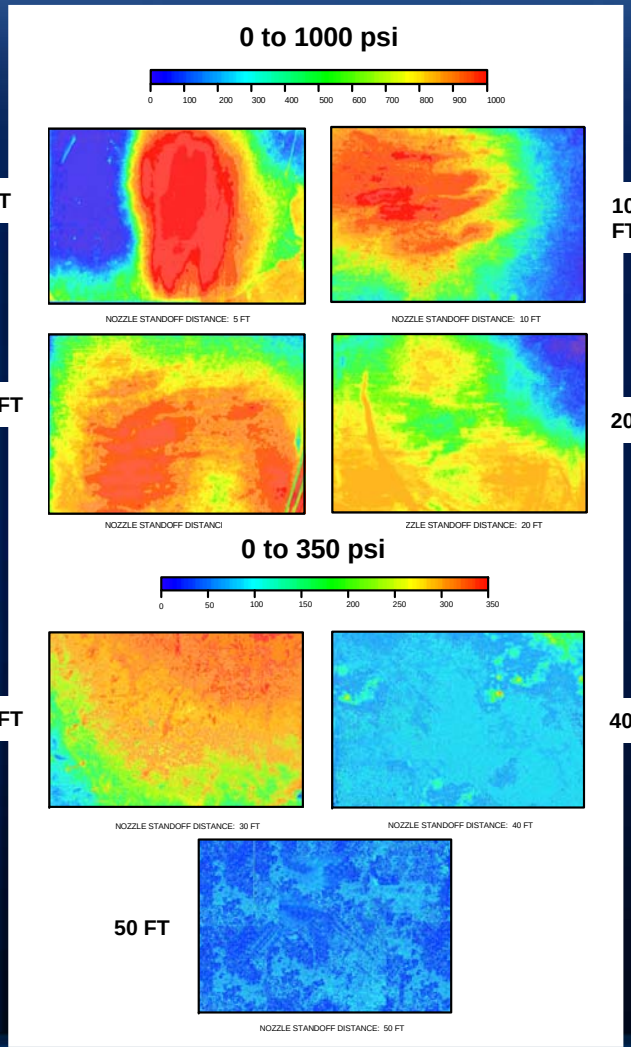
- Designed by WS Darley and Oshkosh Corp.
- Provides 300 gpm at 1300 psi
- Eliminates all hydraulic drives used in the previous UHP-P19
- Reduces weight, size, cost and complexity of components
- Makes a smaller, lighter fire truck with increased water capacity



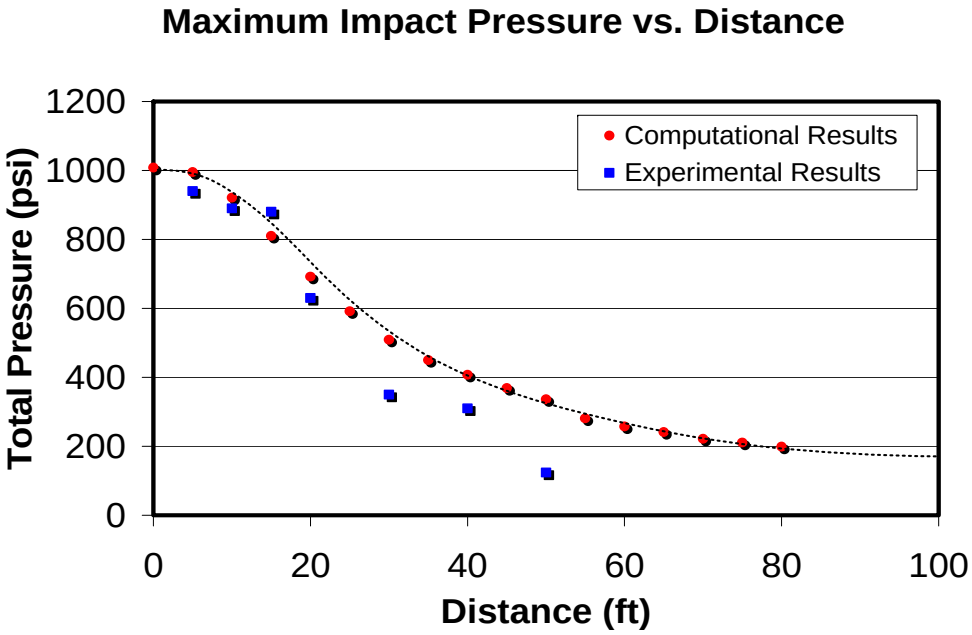
UHP P-19 Modification Overview

- Maj. Gen Eulberg approved $2.5M to modify five P-19's with UHP technology
- Oshkosh Corp. started this program on August 6, 2007
- Five bases with hydrocarbon pits chosen for program
  - Tyndall AFB, FL
  - Dyess, TX
  - Ellsworth, SD
  - Mountain Home, ID
  - Davis Monthan, AZ
- 25 fires per base

Safety Impact Study



- UHP turret nozzle impact measurements are important for operational safety recommendations
- Total dynamic pressure reduces significantly as the jet spreads further from the nozzle
- Total risk of injury is no greater than standard fire fighting delivery methods



HMA All-Terrain Vehicle

- 60 gpm UHP Turret
- 30 gpm Handline
- 300 Gallon Water Tank
- 1100-1500 psi Operational Pressure
- Draft from Alternate Water Source

- Advanced, all-terrain, multipurpose fire/rescue vehicle
- Incorporates the latest technology in ultra high pressure (UHP) water, infrared vision, navigation/tracking/communication systems, and on/off road mobility
- Diverse applications from wildland to Aircraft Rescue Fire Fighting
- New platform for evaluating UHP technologies

Future Developments

- Wild land fire fighting
  - HMA Vehicle
  - Cannon AFB grass fires
- Structural Applications
  - Rosenbauer Systems

Conclusions

- AFRL clearly demonstrated improved fire fighting efficiency through scaled UHP technologies
- Prototype UHP P-19 demonstrated UHP, CAF and combined agent firefighting using commercially available and R&D technology
- UHP nozzle throw tests demonstrated exceptional reach
- UHP foam quality exceeds current standards
- Discharge UHP pressure will not break or penetrate skin
- Next-Gen UHP P-19 will exceed current design standards
- AFRL initiating new UHP technologies through HMA platform
- Initial UHP trucks to be awarded in 2010